



# NDIA PRESENTATION



**MICK L  
BLACKLEDGE**  
[MICK@BLACKLEDGE.NET](mailto:MICK@BLACKLEDGE.NET)

**ISSUES FOR  
SCIENCE AND  
FUTURE ACQUISITION**





# NDIA KEYNOTE TOPICS



- **Evolutionary Fix of Legacy Systems**
- **Proper Threat Physics Definition**
- **Clock Speed Word Length Bandwidth**
- **Defining the Readiness of Technology**
- **NASA and DOD Levels of Incongruity**
- **Physics Based Description of Possibilities**
- **Next Hardware Emulation Architectures**
- **Reimbursable Unintended Consequences**
- **Joint Programs for Future System Science**
- **People Come for Science and Money**



# NDIA KEYNOTE TOPICS



## **Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

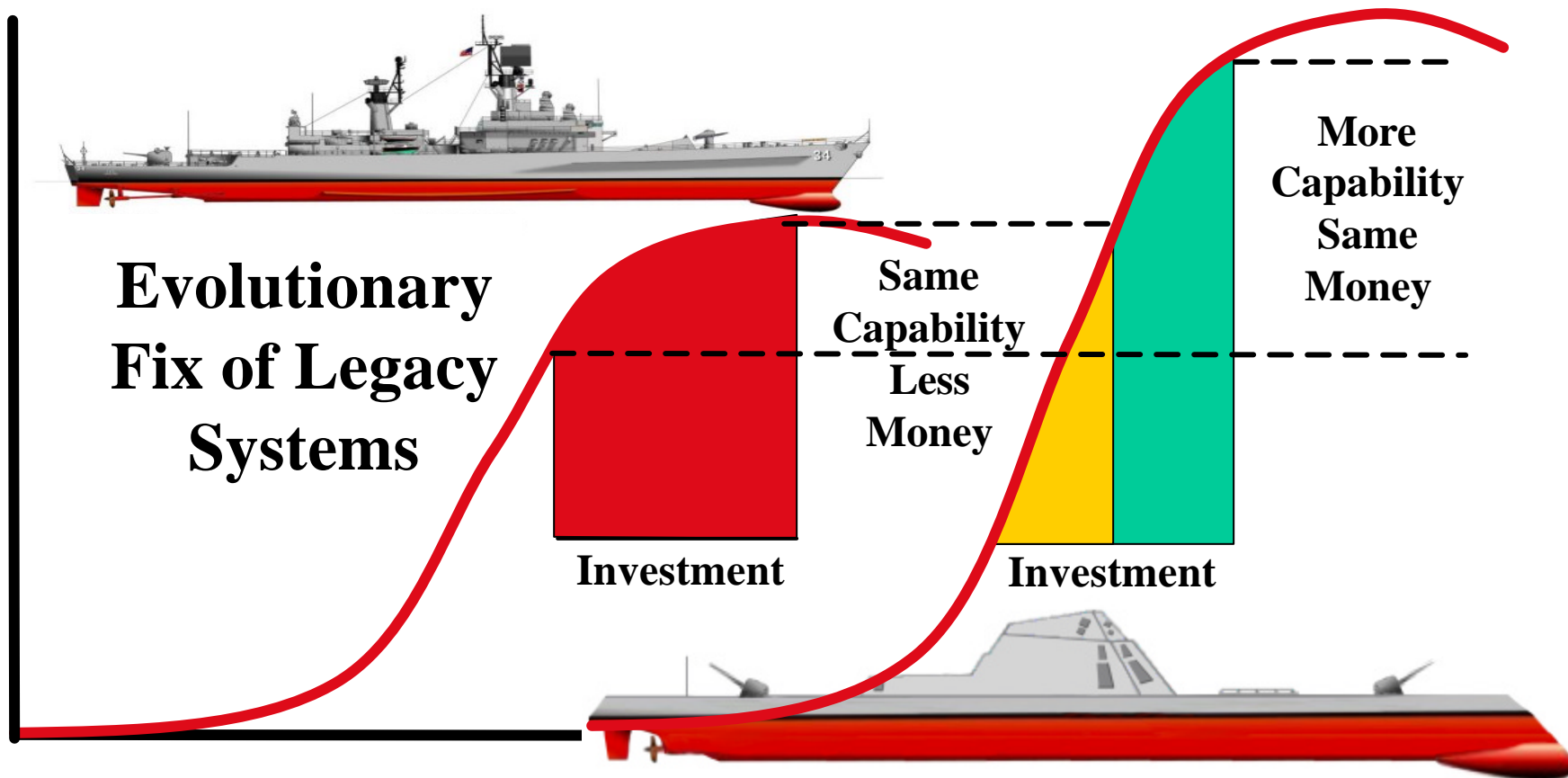
**Reimbursable Unintended Consequences**

**Joint Programs for Future System Science**

**People Come for Science and Money**



# MOVING TO S-CURVE INVESTMENT PAYOFF



There comes a time and requirement wherein one can simply not get there from here without a letting go of the old

**Revolutionary  
Non Legacy Systems**





# OPTIMUM SYSTEMS NEED SINGLE BUILD



**DESIGNING  
FOR  
RETROFIT  
COSTLY IN MONEY  
AND PERFORMANCE**



**AIR DEFENSES**

**The Pylon Problem**



**LAND DEFENSES**

**The Wheelbase Problem**

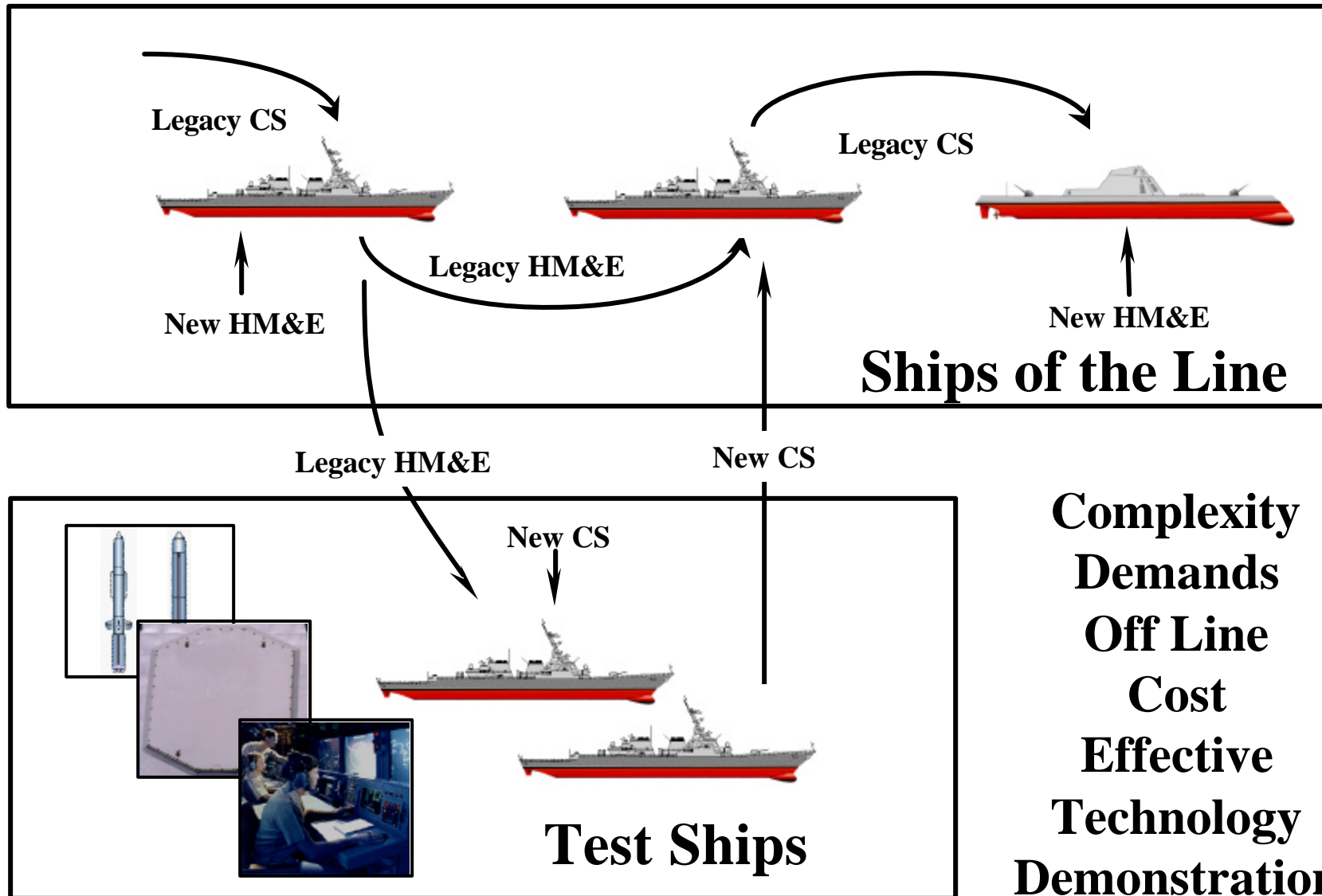


**SEA DEFENSES**

**The Hull Problem**



# SHIPS OF THE LINE AND TEST SHIPS





# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

**Joint Programs for Future System Science**

**People Come for Science and Money**



# TARGET DESIGN REALISTIC CONSTRAINTS



## VEHICLE MANUFACTURE

CENTER OF GRAVITY

ANGLE OF ATTACK

NOSE TIP AND SHIELD



## DEPLOYMENT DYNAMICS

SPIN RATE

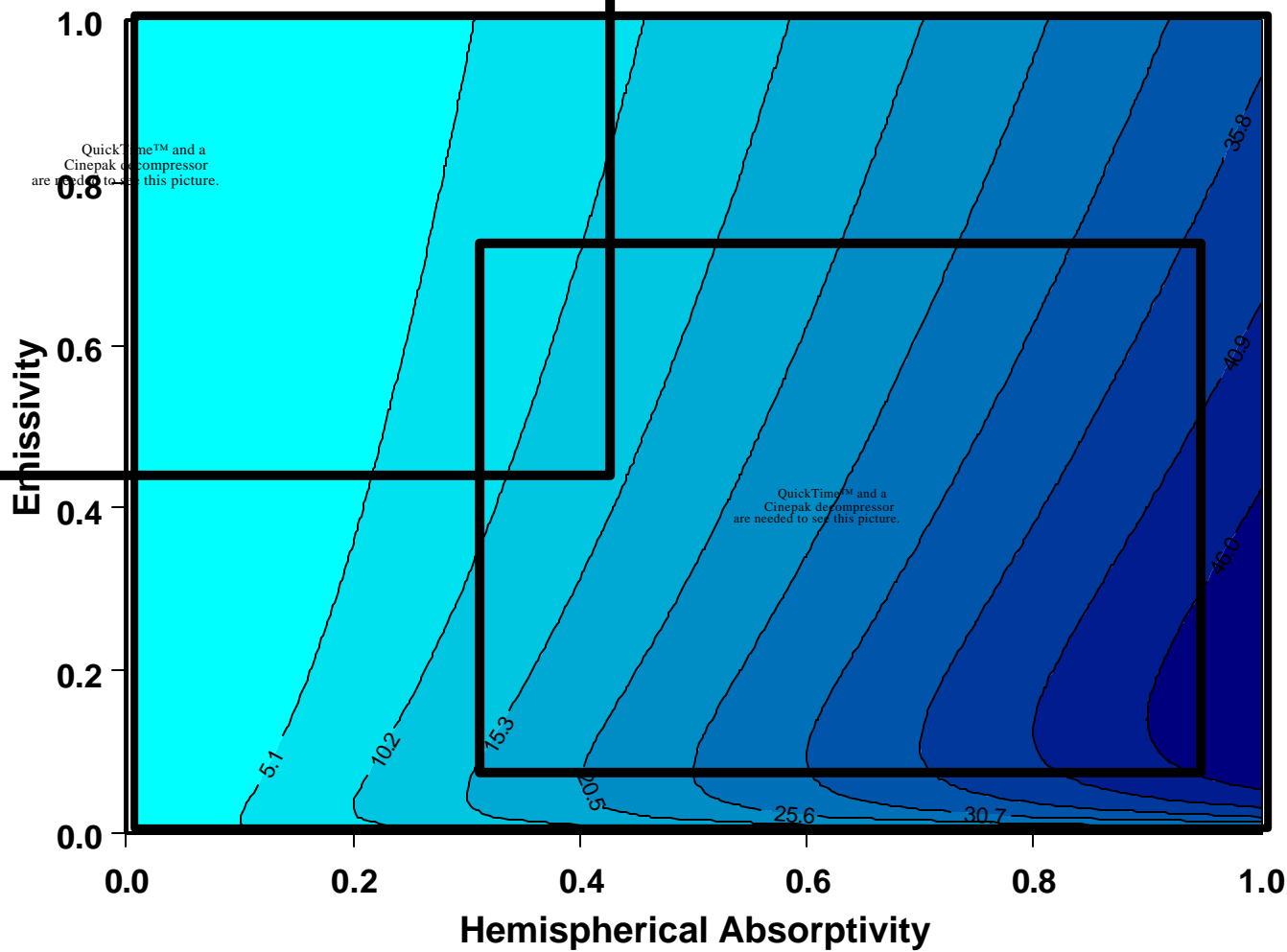
ANGULAR RATE

EJECT VELOCITY

TRIM BETA SPIN TIPOFF VELOCITY GAMMA



# REAL TIME VERSUS COMPUTER TIME





# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

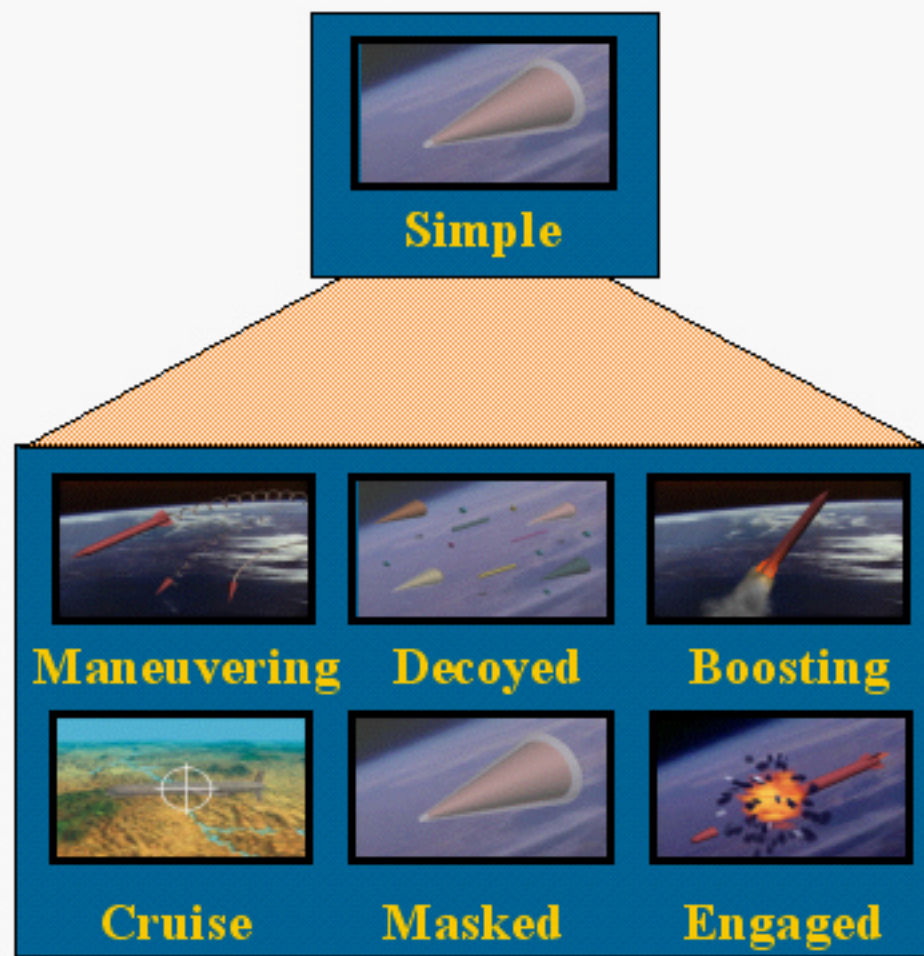
**Joint Programs for Future System Science**

**People Come for Science and Money**

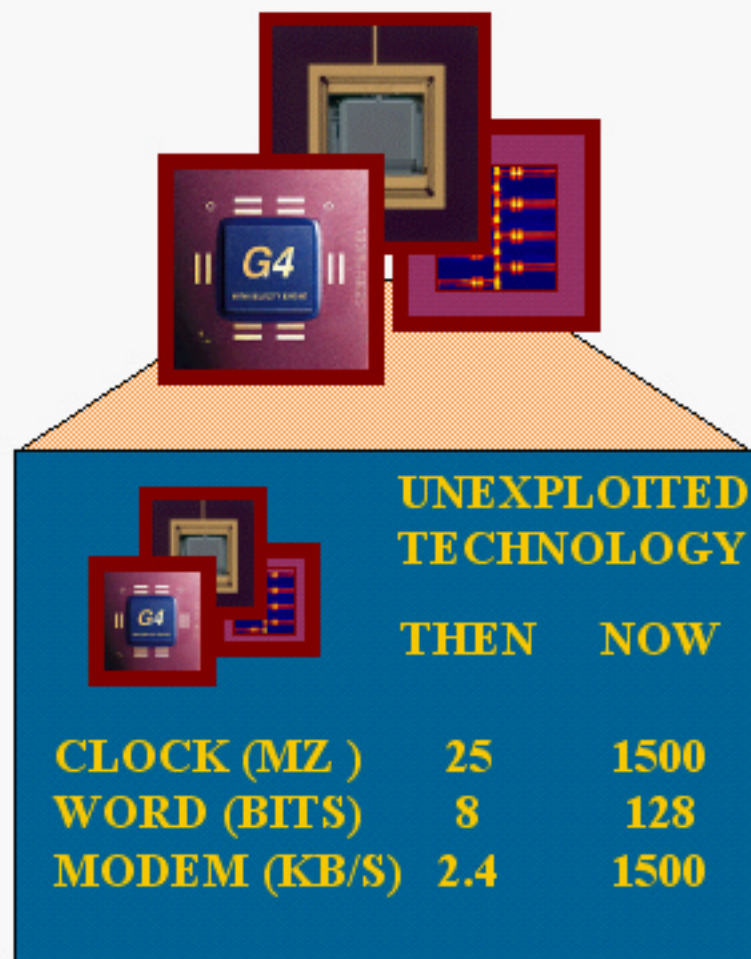




# EIGHT YEAR CHANGES



THREAT GROWTH



TECHNOLOGY GROWTH





# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

**Joint Programs for Future System Science**

**People Come for Science and Money**



# TECHNOLOGY ORGANIZATIONS



300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400
300-02	PMO TSC	Henry L. Loh	400



**Tom Eubanks APL**



**Technology PM**



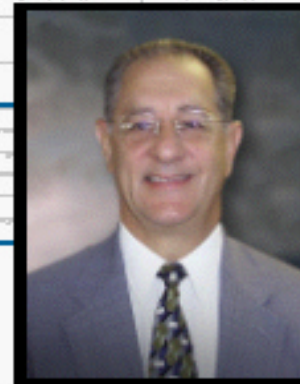
**Eric Evans LL**



**Edward English LNL**



**Peter Wilhelm NRL**



**Chris Kalivretenos NWC**

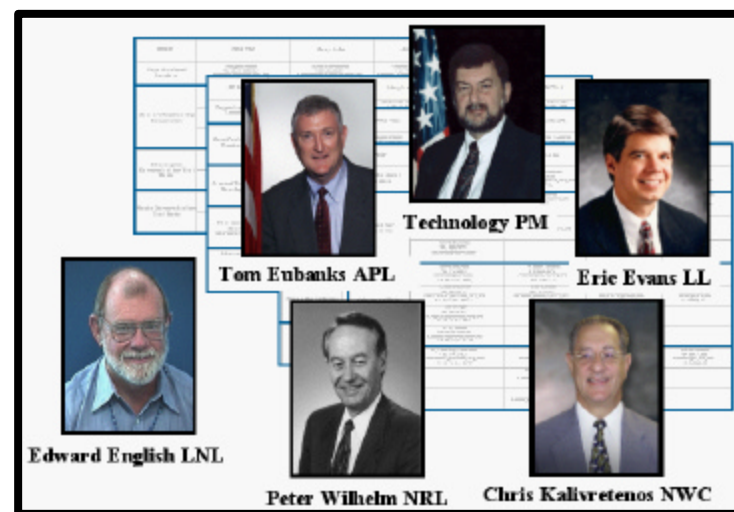
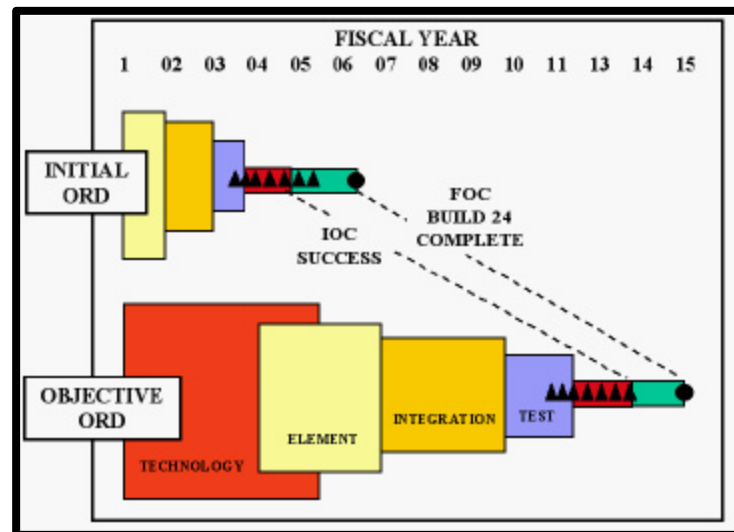


# TECHNOLOGY AND TESTING GOVERNMENT ASSESSMENTS



		S-Band				X-Band			
		FY 05 / 06		FY 09		FY 05 / 06		FY 09	
		Current TRL <sup>1</sup>	Risk Factor <sup>2</sup>	Current TRL <sup>1</sup>	Risk Factor <sup>2</sup>	Current TRL <sup>1</sup>	Risk Factor <sup>2</sup>	Current TRL <sup>1</sup>	Risk Factor <sup>2</sup>
High Power Modules	SiC GaN	3	0.15	3	0.09	3	0.63	2	0.81
		—	—	—	—	4	0.30	3	0.20
Thermal Management	Component Module Array	3	0.35	3	0.30	2	0.25	2	0.25
		3	0.25	2	0.15	2	0.20	2	0.20
		4	0.28	4	0.35	4	0.28	4	0.35
Digital Radar Architectures	Control Integration ADC's	2	0.40	2	0.24	2	0.40	2	0.40
		3	0.40	2	0.24	2	0.24	2	0.07
		6	0.06	6	0.06	6	0.06	6	0.06
Algorithm Architectures	Jammer Clutter Wideband	3	0.28	3	0.21	2	0.28	2	0.21
		3	0.35	3	0.35	3	0.35	3	0.35
		3	0.30	3	0.25	3	0.30	3	0.25
Program Independent Software	Open System	4	0.20	4	0.10	4	0.20	4	0.10

Notes: 1) Current TRL assessment against need date requirements.  
2) Risk Factor for attaining TRL-6 capability at insertion point





# REQUIREMENTS FOR ALL SOURCES



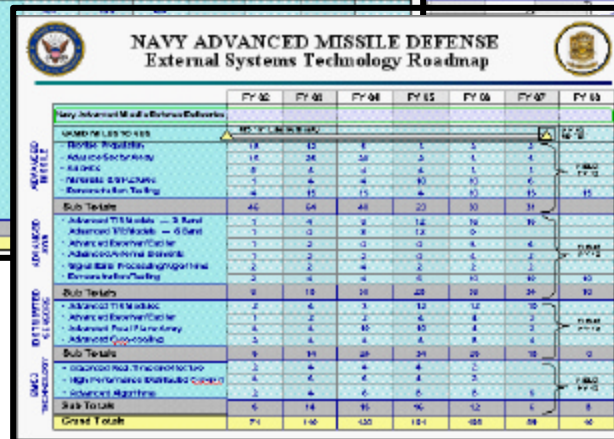
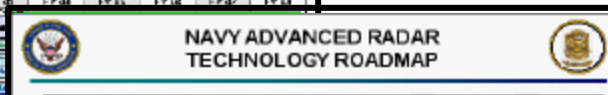
**DARPA**

**BMDO**

**ONR**

**INDUSTRY**

**INTERNATIONAL**



**BILLIONS**



# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

**Joint Programs for Future System Science**

**People Come for Science and Money**



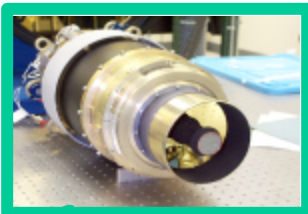


# TECHNOLOGY READINESS LEVELS



Engineering Manufacturing Development

9  
8  
7  
6  
5  
4  
3  
2  
1  
0



SM 3

Critical  
Jump



LEAP

Form and Fit

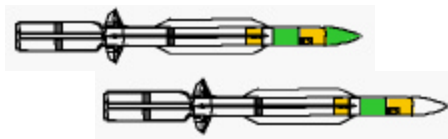
Flight Test

Ground Test

Integration

Concept

Evolutionary

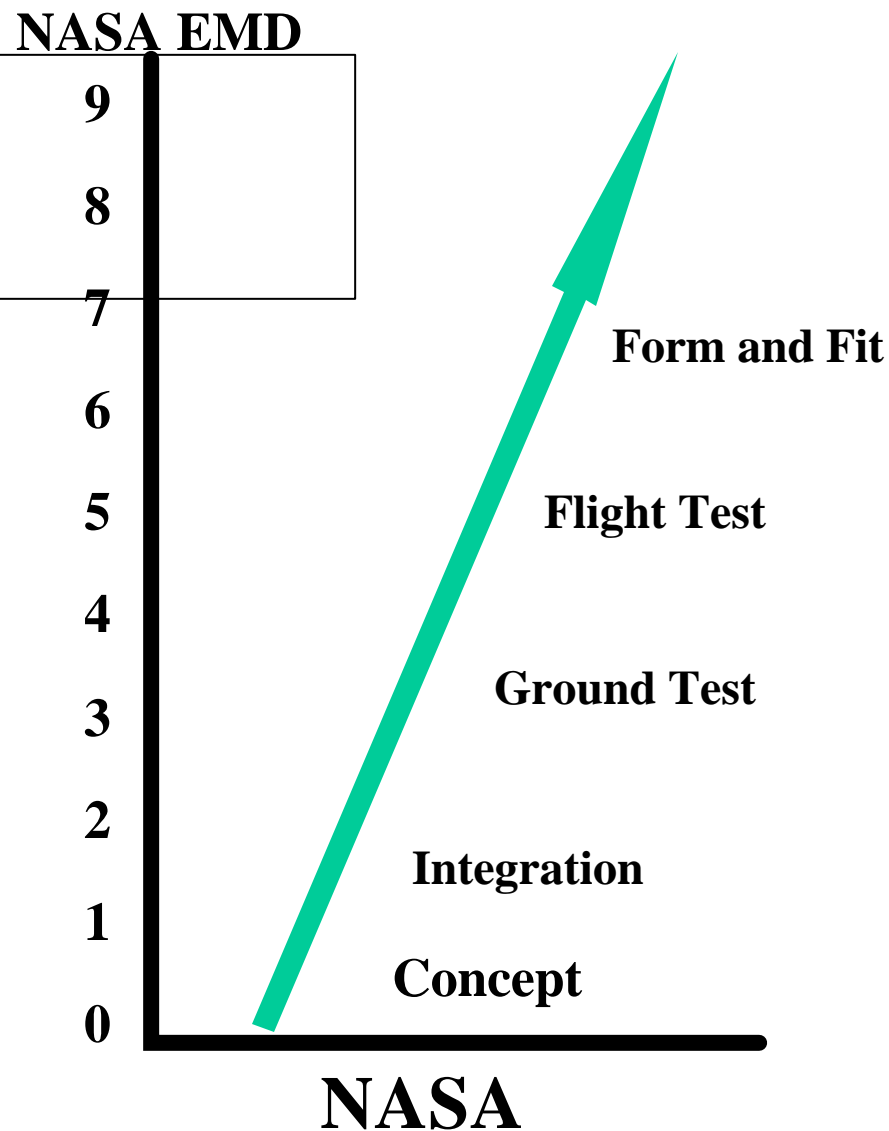
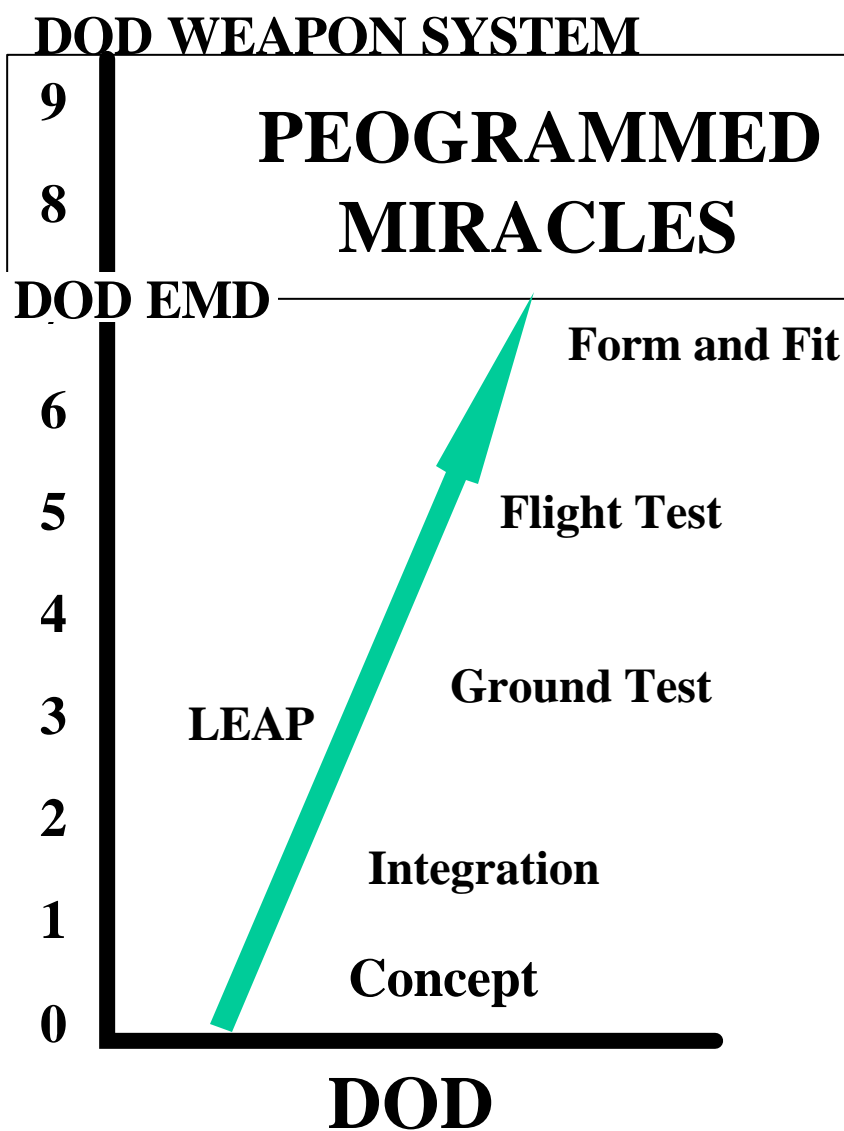


Revolutionary





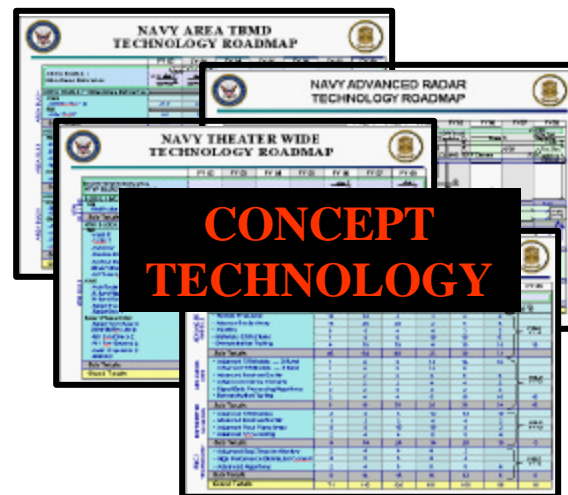
# DIFFERING READINESS LEVELS







# CONSTANT THREAD CAPABILITIES



## THREAT AND FUNCTION DRIVEN





# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

**Joint Programs for Future System Science**

**People Come for Science and Money**



# REVISIT ARCHITECTURE AND TECHNOLOGY



## WEAPONS



## SYSTEM ENGINEERING




**IMAGE EXTRACTION**  
**RANGE RANGE RATE**  
**ANGULAR RESOLUTION**  
**NORMAL ACCELERATION**  
**ON DEMAND PROPULSION**

**MULTI MODE**

**AIR DEFENSE**  
**LAND ATTACK**  
**MISSILE DEFENSE**  
**LOW OBSERVABLE DEFENSE**

**128 Bits 500 Megahertz**

## SURVEILLANCE




**S BAND**



**ULTRA WIDE BAND**



**X BAND**

**RANGE RANGRATE**  
**FEATURE IMAGING**  
**DOPPLER IMAGING**  
**CROSSRANGE MOTION**  
**HYPER RESOLUTION**  
**EDGE DETECTION**  
**MICRO DYNAMICS**  
**MACRO DYNAMICS**  
**NORMAL ACCELERATION**  
**COHERENT INTEGRATION**

**128 Bits 500 Megahertz**

## COMBAT SYSTEMS



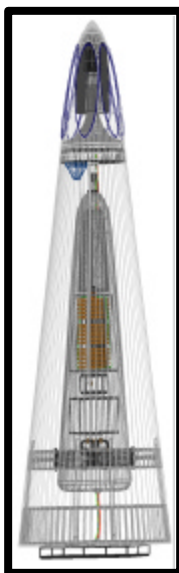
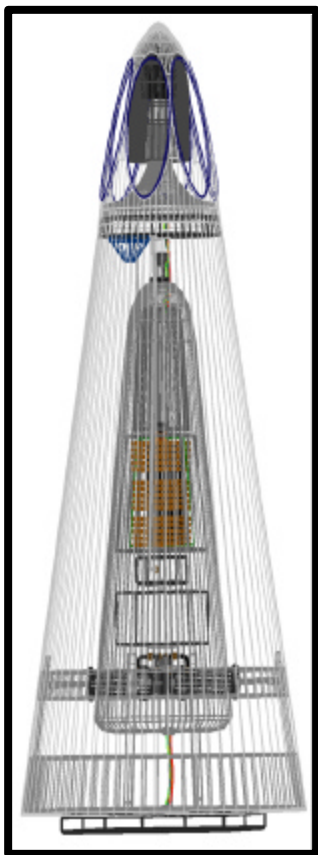



**REQUIREMENTS FOR 2010**





# ULTIMATE MISSILE



**MULTI-MODE**

**AIR DEFENSE  
LAND ATTACK  
MISSILE DEFENSE  
LOW OBSERVABLE DEFENSE**

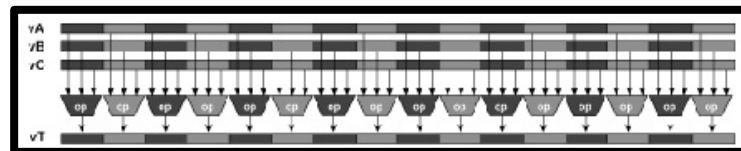
**IMAGE EXTRACTION**

**RANGE RANGE RATE**

**ANGULAR RESOLUTION**

**NORMAL ACCELERATION**

**ON DEMAND PROPULSION**



**128 Bits 2000 Megahertz**



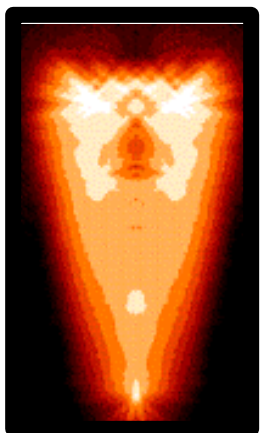
# ULTIMATE RADAR



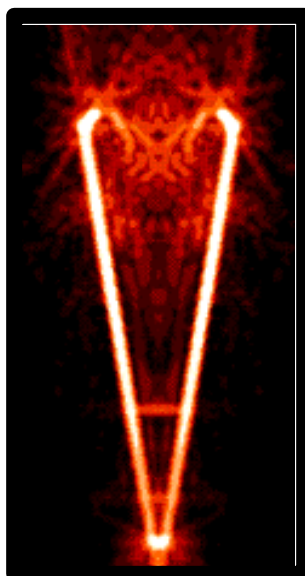
**VISIBLE  
WIDE  
BAND**



**S BAND**

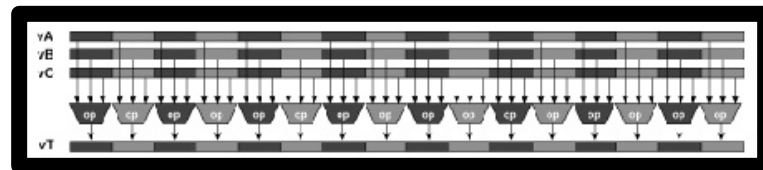


**X BAND**



**ULTRA  
WIDE  
BAND**

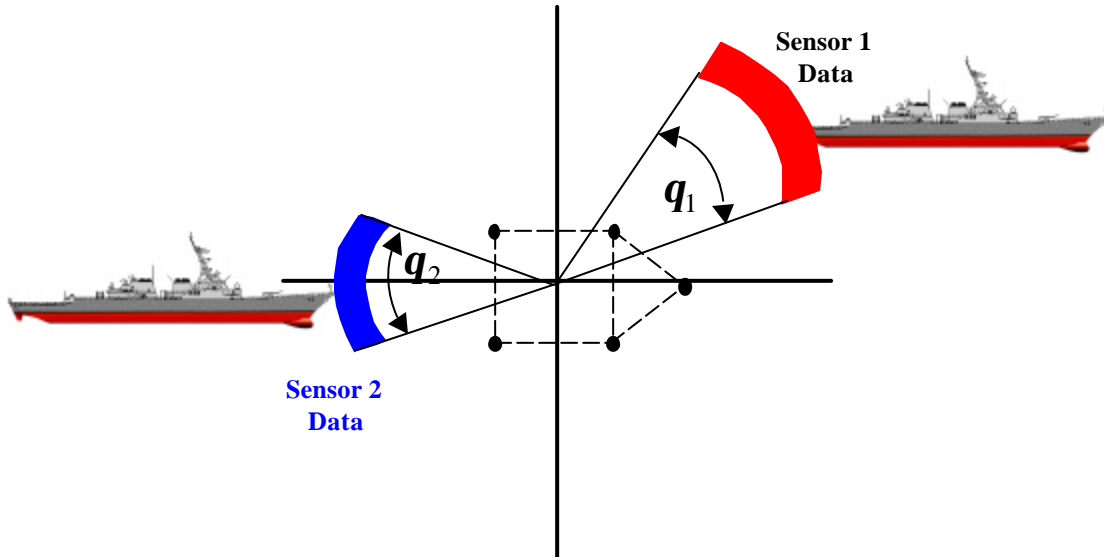
**RANGE RANGE RATE  
FEATURE IMAGING  
DOPPLER IMAGING  
CROSS RANGE MOTION  
HYPER RESOLUTION  
EDGE DETECTION  
MICRO DYNAMICS  
MACRO DYNAMICS  
NORMAL ACCELERATION  
COHERENT INTEGRATION**



**128 Bits 2000 Megahertz**

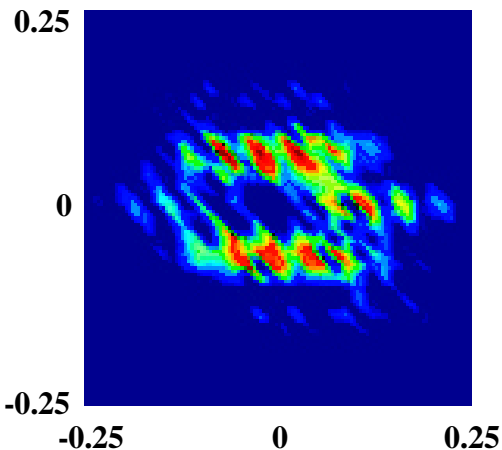


# ULTIMATE BATTLE MANAGEMENT

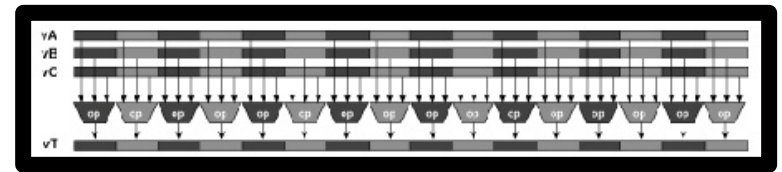
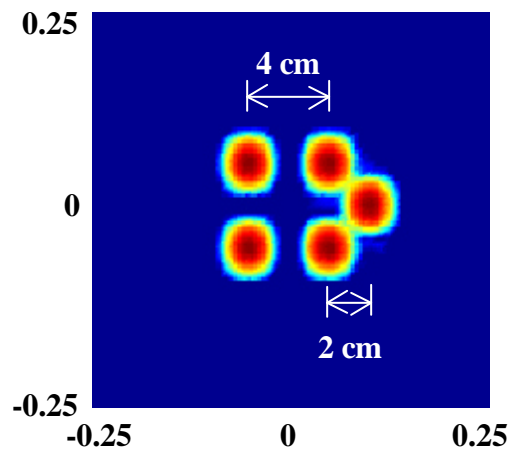


**SCENE REGISTRATION**  
**CRITICAL STRIKE RATES**  
**FULL VIDEO RATES**  
**EDGE DETECTION**  
**MOTION DETECTION**  
**FORCE NET LINKAGE**  
**NANOSECOND CLOCKS**  
**MULTI DYNAMIC RADAR**  
**LOSSLESS COMPRESSION**

**Conventional**



**BMC4 Fusion**



**128 Bits 2000 Megahertz**





# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

**Joint Programs for Future System Science**

**People Come for Science and Money**



# FULL IMAGE TIME AND SPACE DATA SET

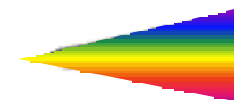


Infrared



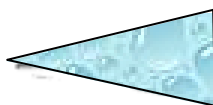
Angle Angle

Radar



Range Doppler

Ladar



Range Doppler

Chromatic



Angle Angle

Multispectral

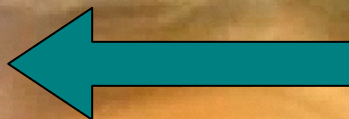


Angle Angle

Emissivity  
0.6  
0.4

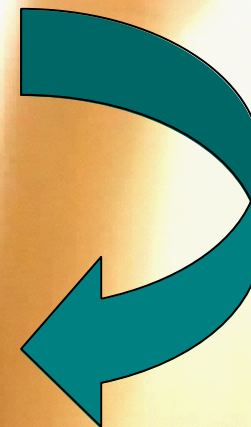


# STREAMING VIDEO COMMERCIAL DRIVER



**INSTEAD OF THIS**

**HOW TO DO THIS**



**FULL SCREEN VIDEO**





# IMAGE CONVOLUTION



**Spatial and Temporal  
Analysis**

**Uniformity  
Correction**

**Sub Pixel Resolution**

**Dynamic Range**

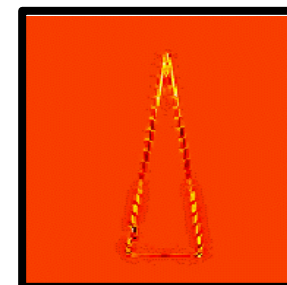
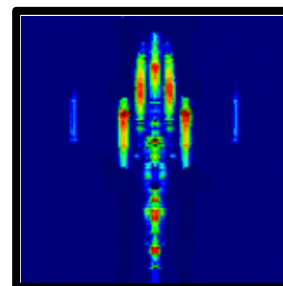
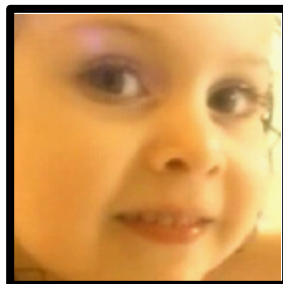
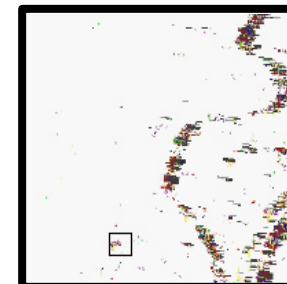
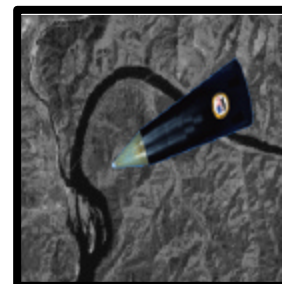
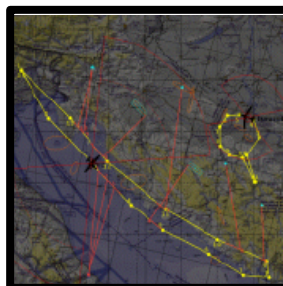
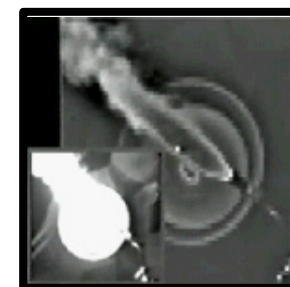
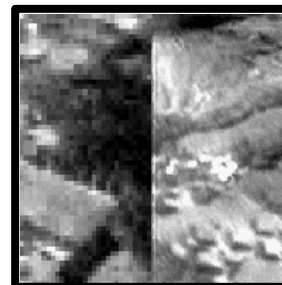
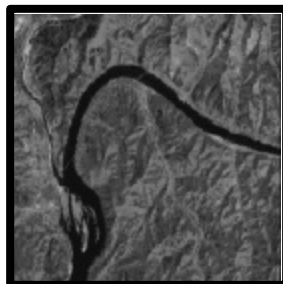
**Edge Detection**

**Velocity Fields**

**Motion Detection**

**Data Compression**

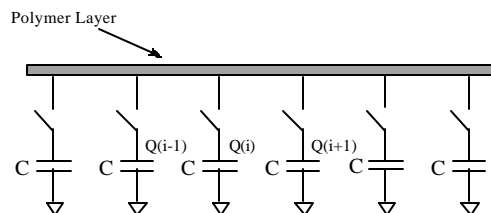
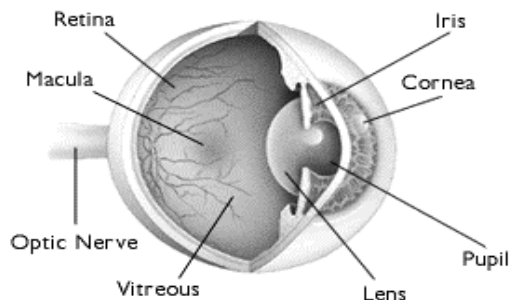
**Scene Registration**







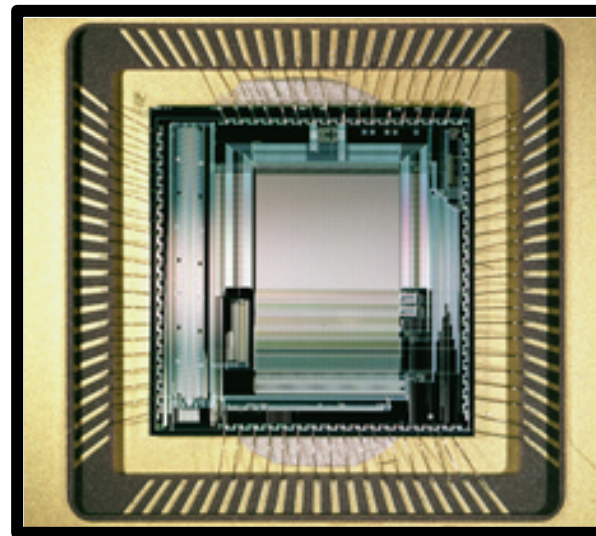
# CONVOLUTIONS TOO CHEAP TO METER



$$N \equiv \sqrt{\frac{T}{RC}}$$

**N = Pixels Blurred**    **T = Switch Closed**  
**C = Net Capacitance**    **R = Polymer Resistivity**

## Analog Image Processing



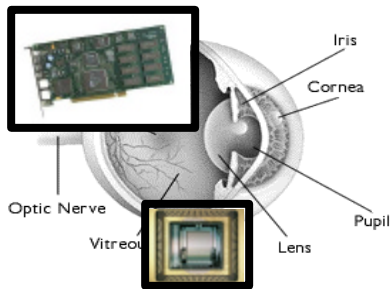
**Hybrid Silicon ASIC**  
**Conjugated Polymer Device**



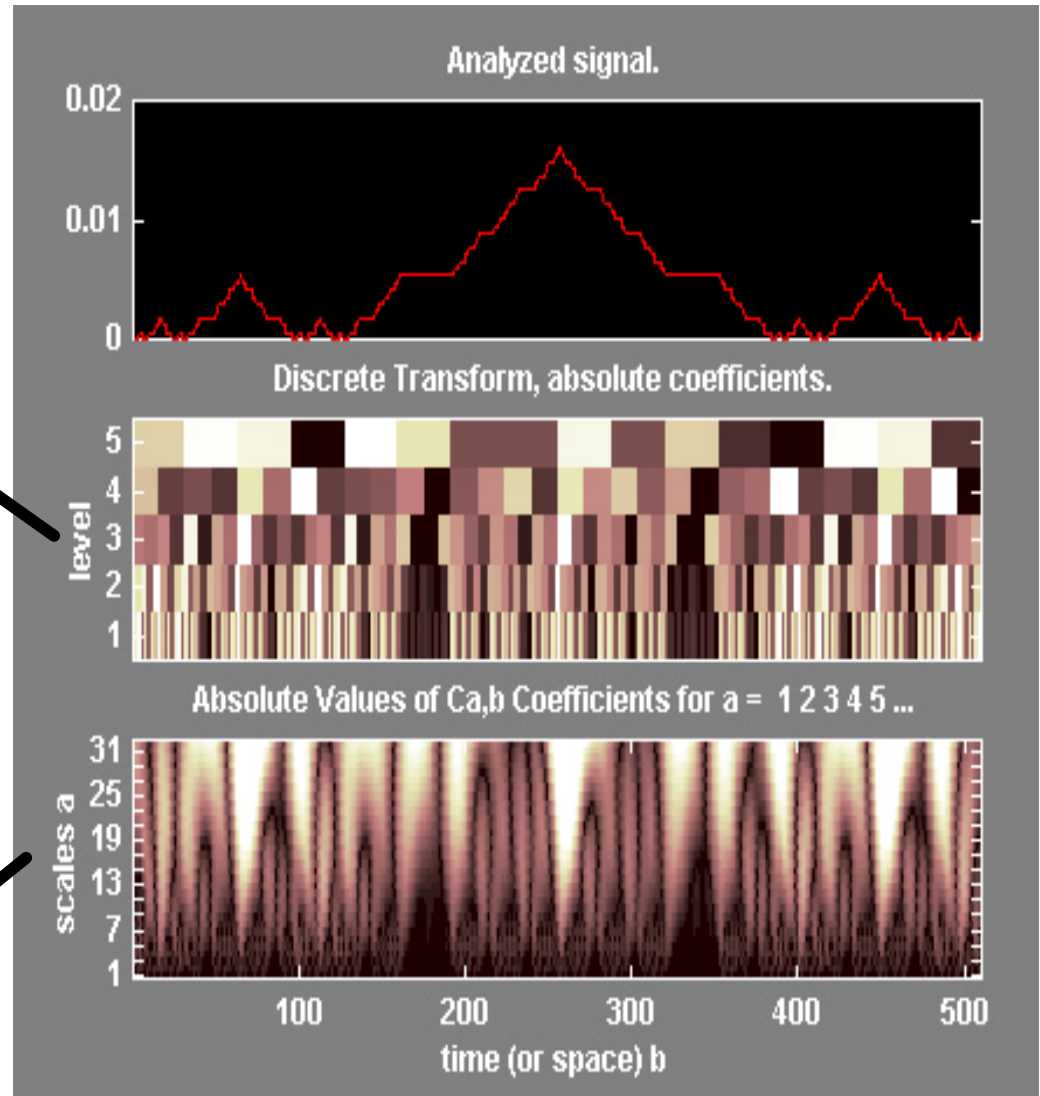
# DISCRETE AND CONTINUOUS WAVELET TRANSFORMS



**Digital Parallel  
Gate Arrays**

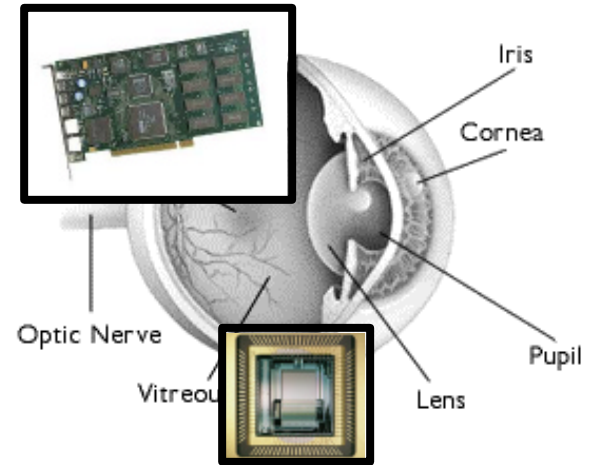


**Analogue Silicon  
Retinal Arrays**





# SPATIAL TEMPORAL MOTION SPACE



## Analogue Silicon Retinal Arrays



## Digital Parallel Gate Arrays

MERIT	ASIC	TAIP
CHIPS		
TFLOPS		
POWER		





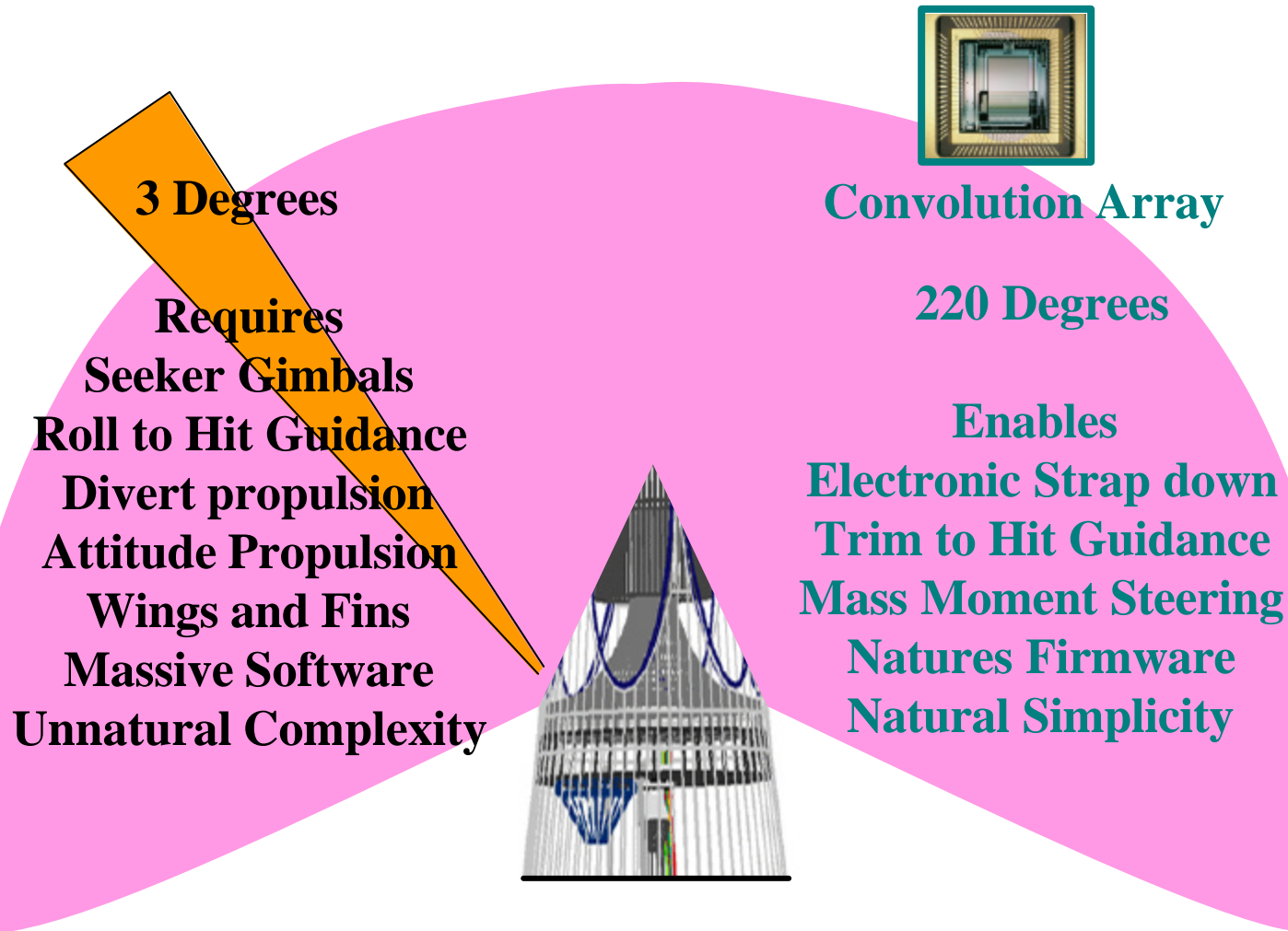
# COMPARISON OF ASIC AND TAIP CHIPS



Image format (kernel size)	UNITS	ASIC DSP	TAIP Array
256 x 256 (8 x 8)	MFLOPS	184	184
	Power (W)	1	0.1
	# of chips	1	1
1000 x 1000 (8 x 8)	GFLOPS	1.8	1.8
	Power (W)	16	1.6
	# of chips	16	1
2000 x 2000 (32 x 32)	TFLOPS	0.1	0.1
	Power (W)	1024	6.4
	# of chips	1024	1

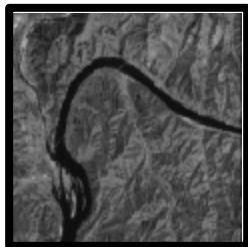


# CONVOLUTION SEEKER MISSILE DESIGN

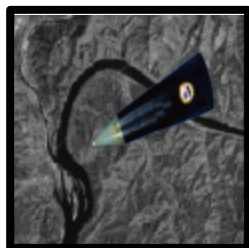




# COMPUTATIONAL MACHINES



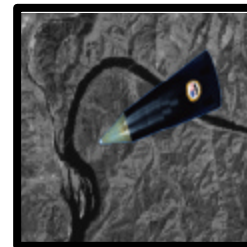
**LASER  
WAVE FRONT**



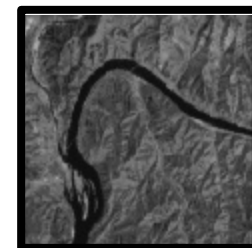
**SUB PIXEL  
RESOLUTION**



**MOTION  
TRACKING**

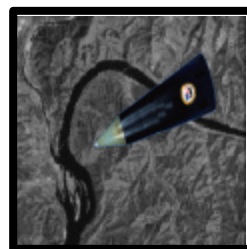
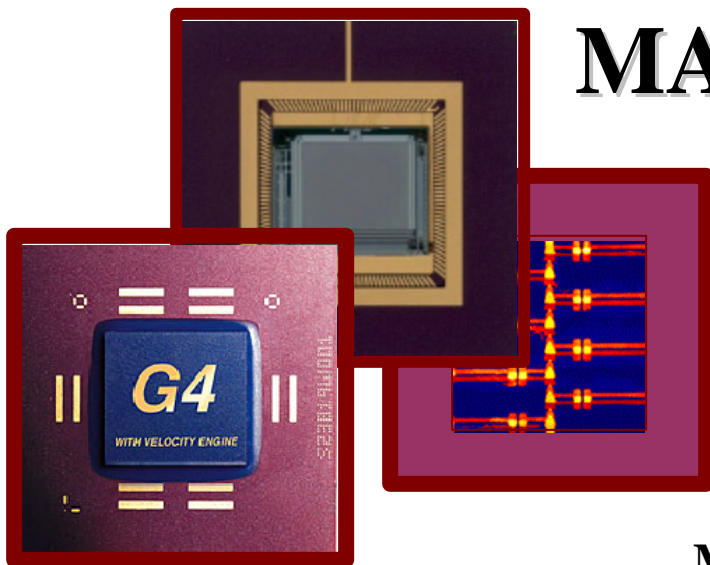


**UNIFORMITY  
CORRECTION**

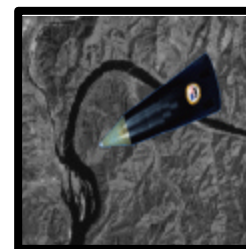


**BMC4I  
COMPRESSION**

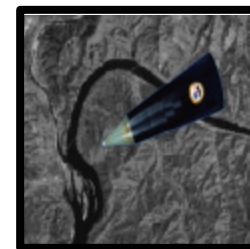
## NEW CHIP MATHEMATICS



**SENSOR MULTI SPECTRAL**



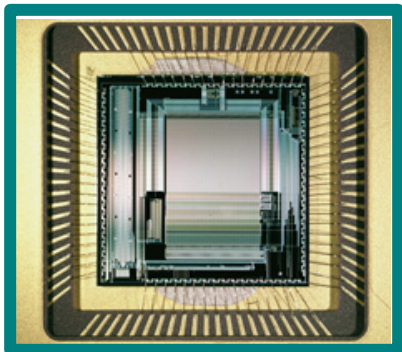
**SENSOR**



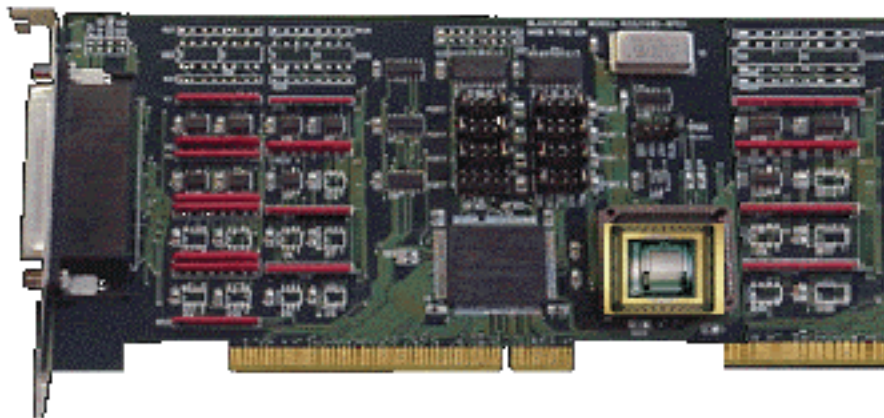
**SENSOR  
MULTI PATH**



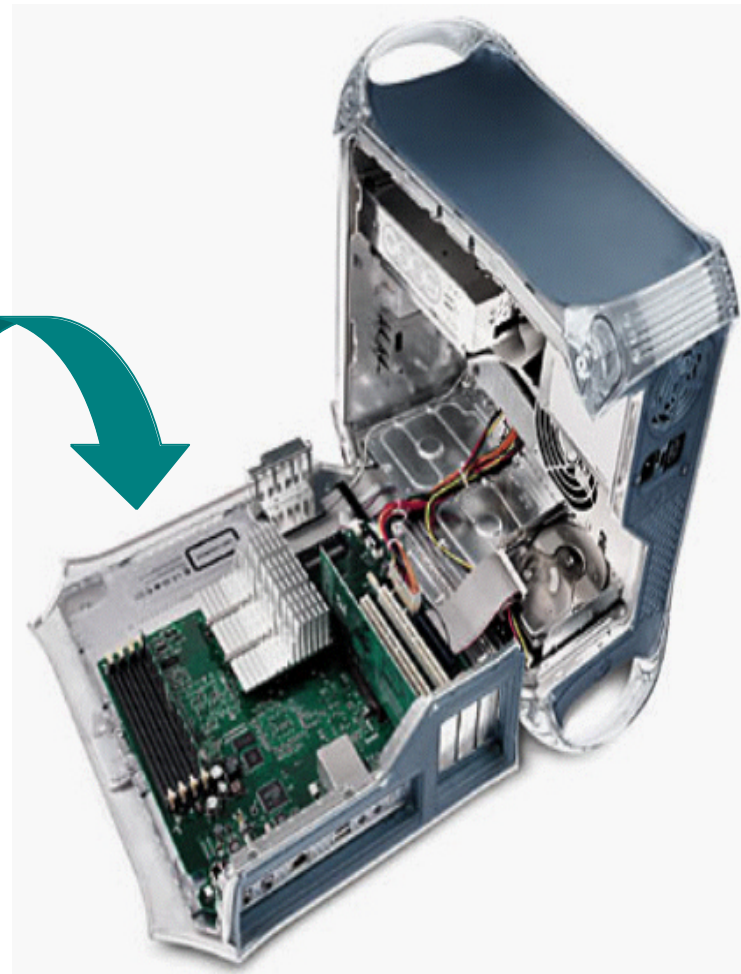
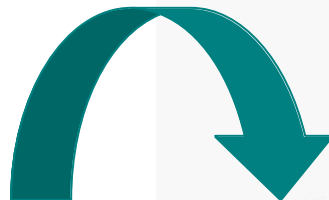
# TAPPING 200 MILLION TALENTS



**Convolution Array**



**Convolution Engine PCI**



**Convolution Desktop**



# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

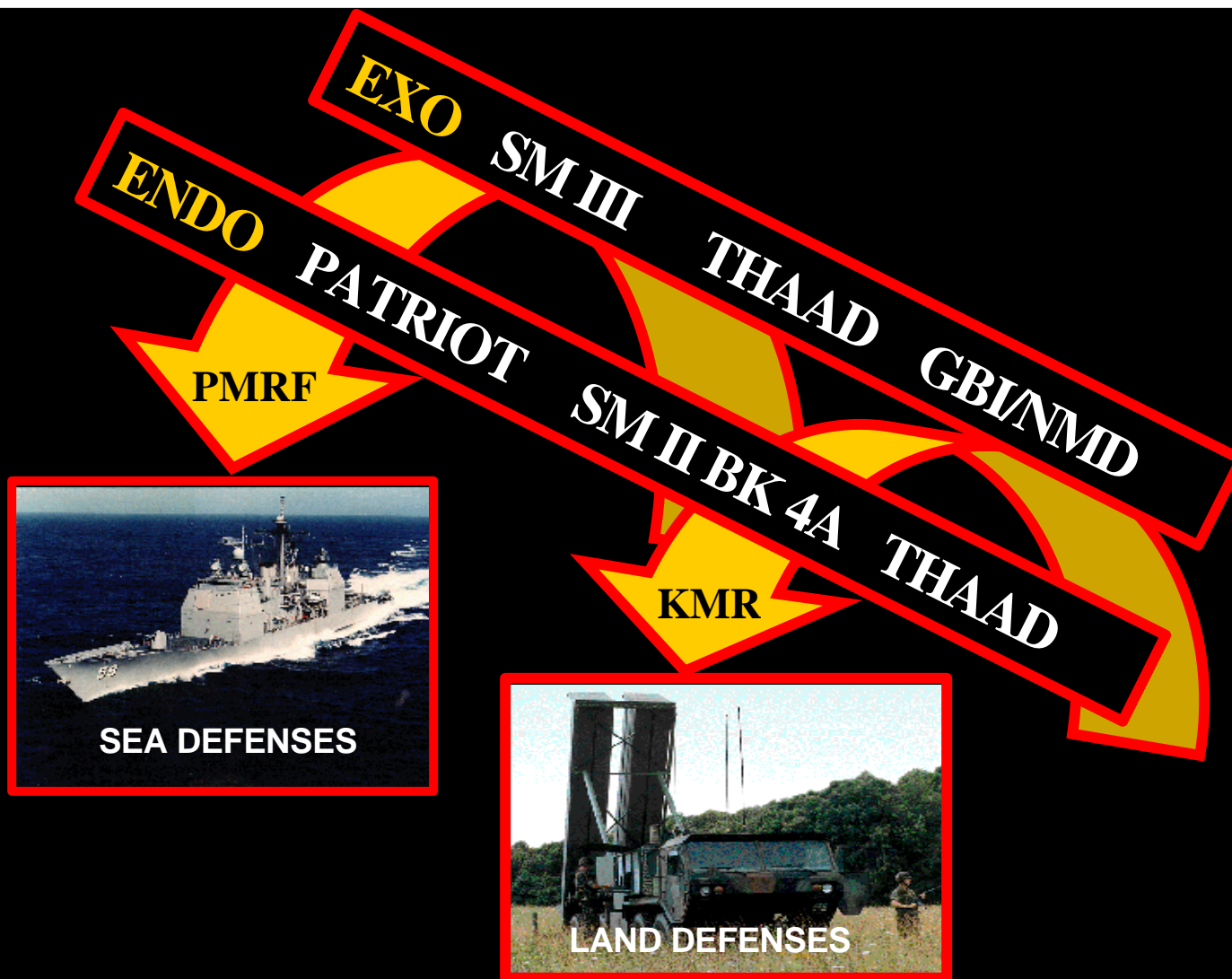
**Joint Programs for Future System Science**

**People Come for Science and Money**





# SAME TEST ISSUES AT TWO RANGES





# KREMS OPERATIONAL ASSETS





# SIMILAR MISSIONS UNSHARED TESTING GOALS



**EXISTING  
INFRASTRUCTURE  
BMDO DEFENSE**





# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

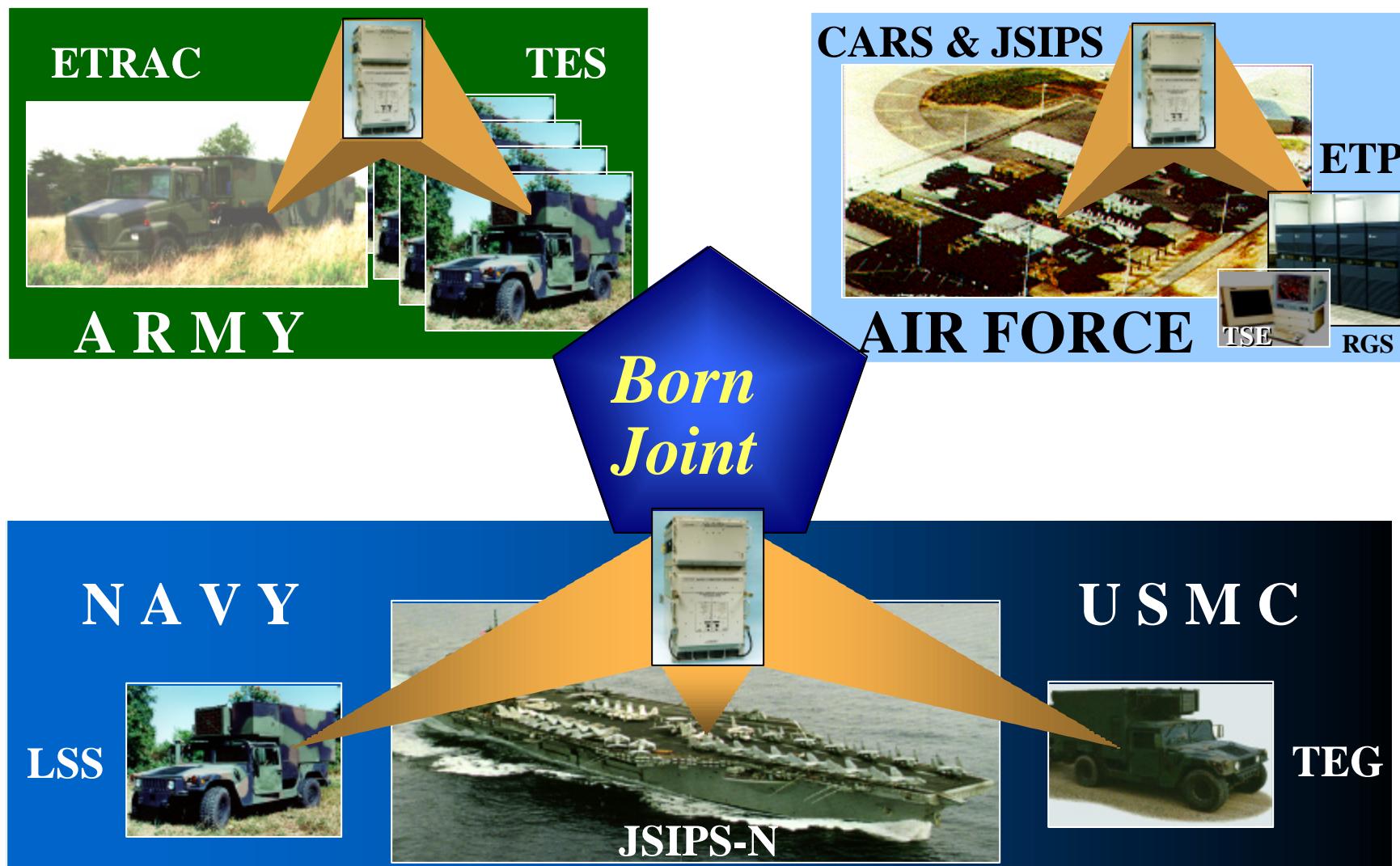
**Joint Programs for System Science**

**People Come for Science and Money**





# A JOINT SYSTEM



Standard Hardware   Common Software   Assured Interoperability   Streamlined Logistics





# HIGHLY EFFECTIVE PROGRAM INVESTMENT



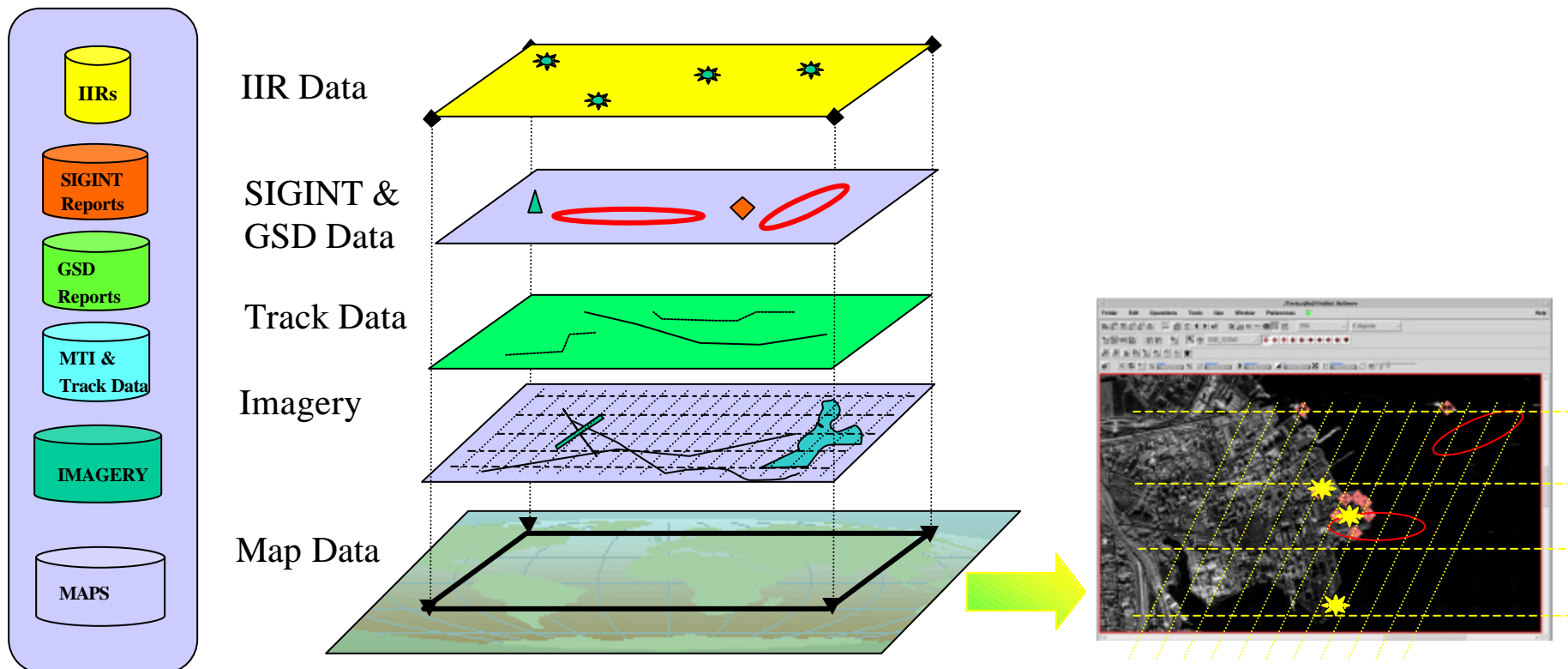
**Operational In the Army**  
**Proven On The Coronado**  
**Assured Service Interoperability**  
**Strong User Demand**  
**Leverages Commercial Technology**



## **REAL CAPABILITY AVAILABLE NOW**



# IMAGE REGISTRATION INFRASTRUCTURE



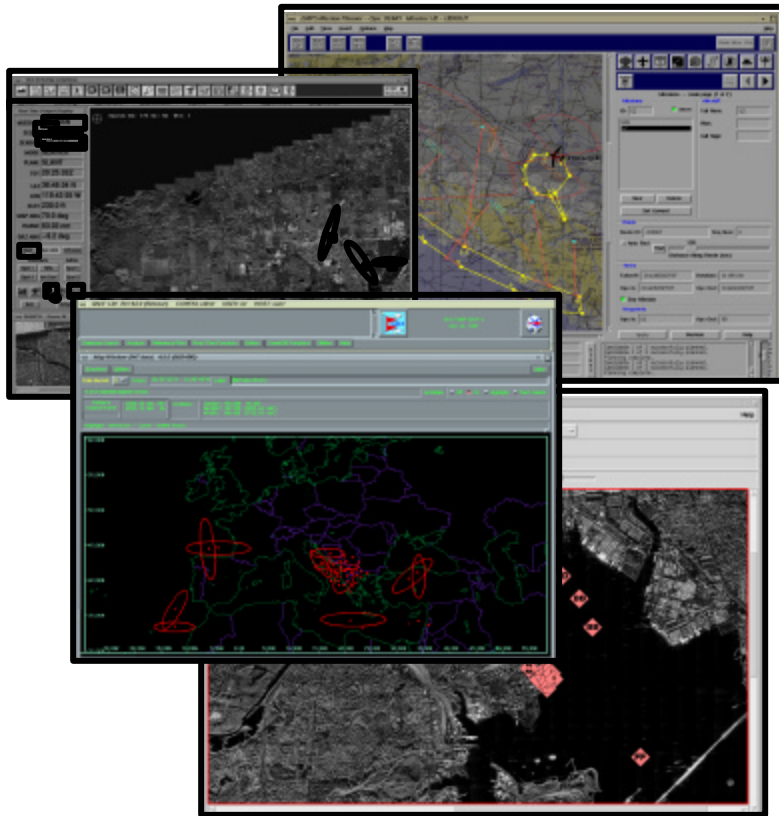
**REAL TIME ACCESS TO ALL SENSORS**



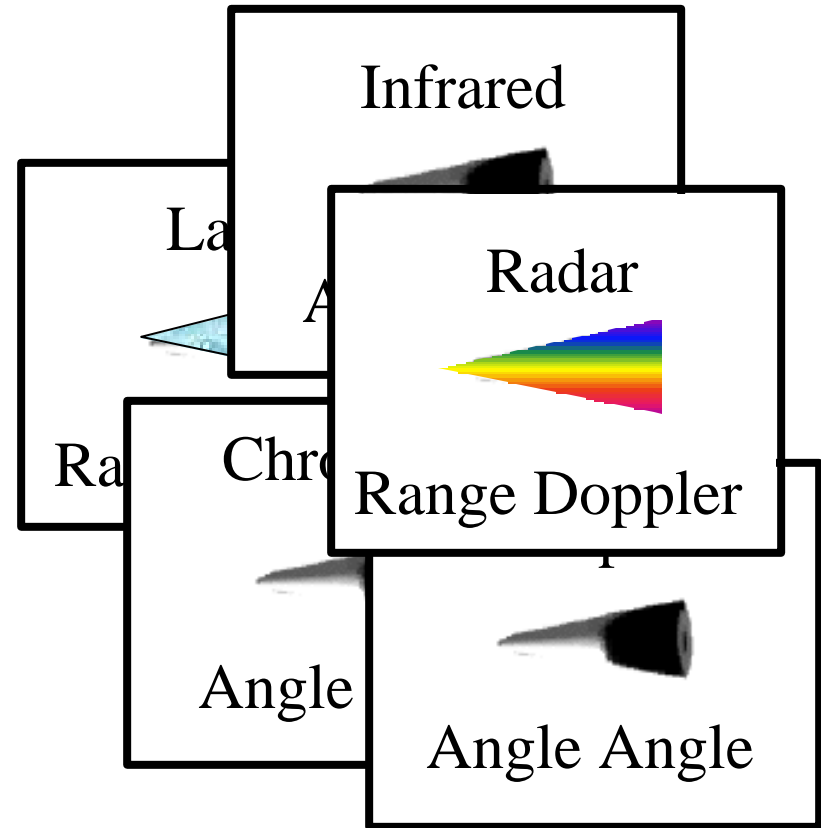
# TRANSFER IMAGE BASED BMC4 METHODOLOGY



## Threat Strike



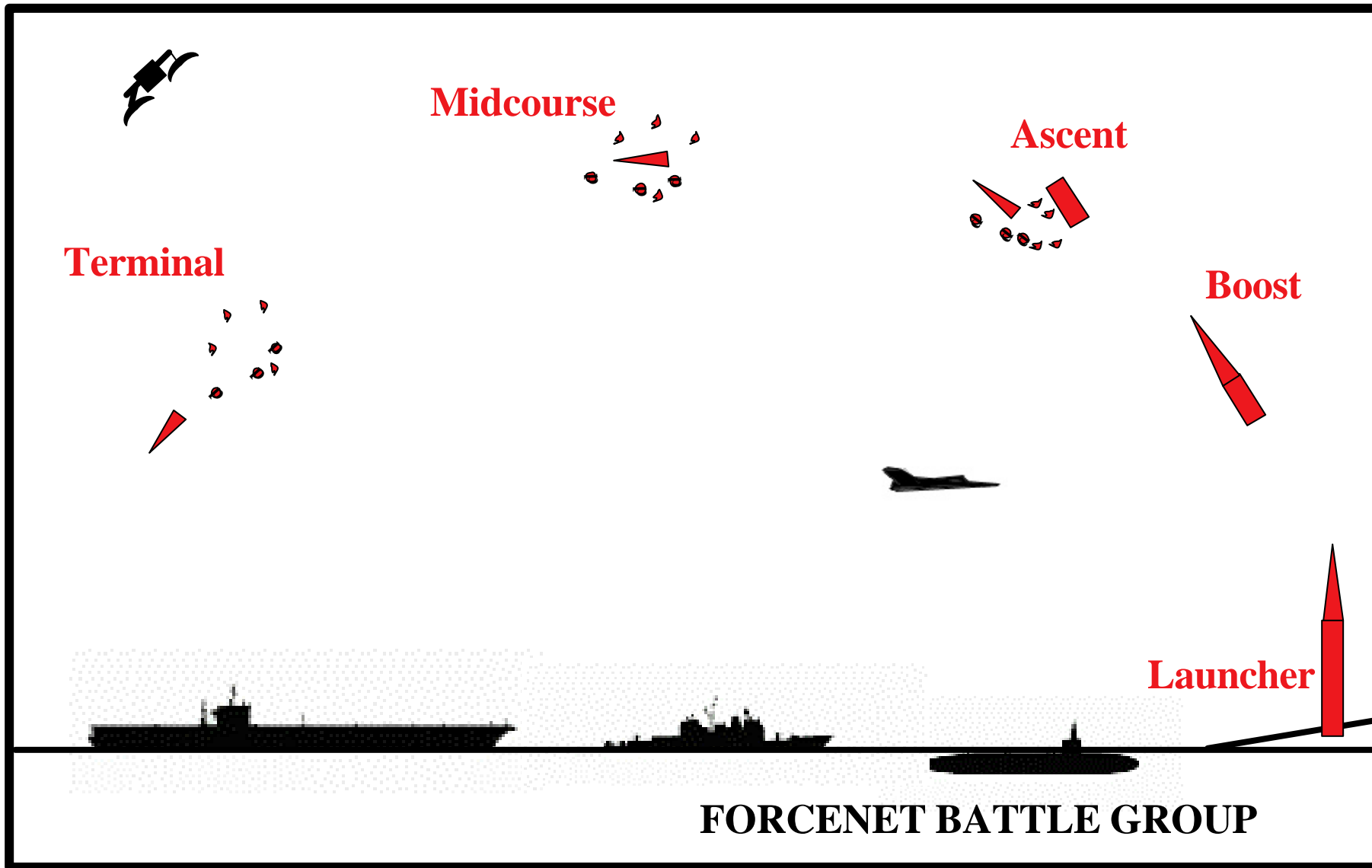
## Threat Defense



**All Workstations Identical  
'Windows For The Warrior'**

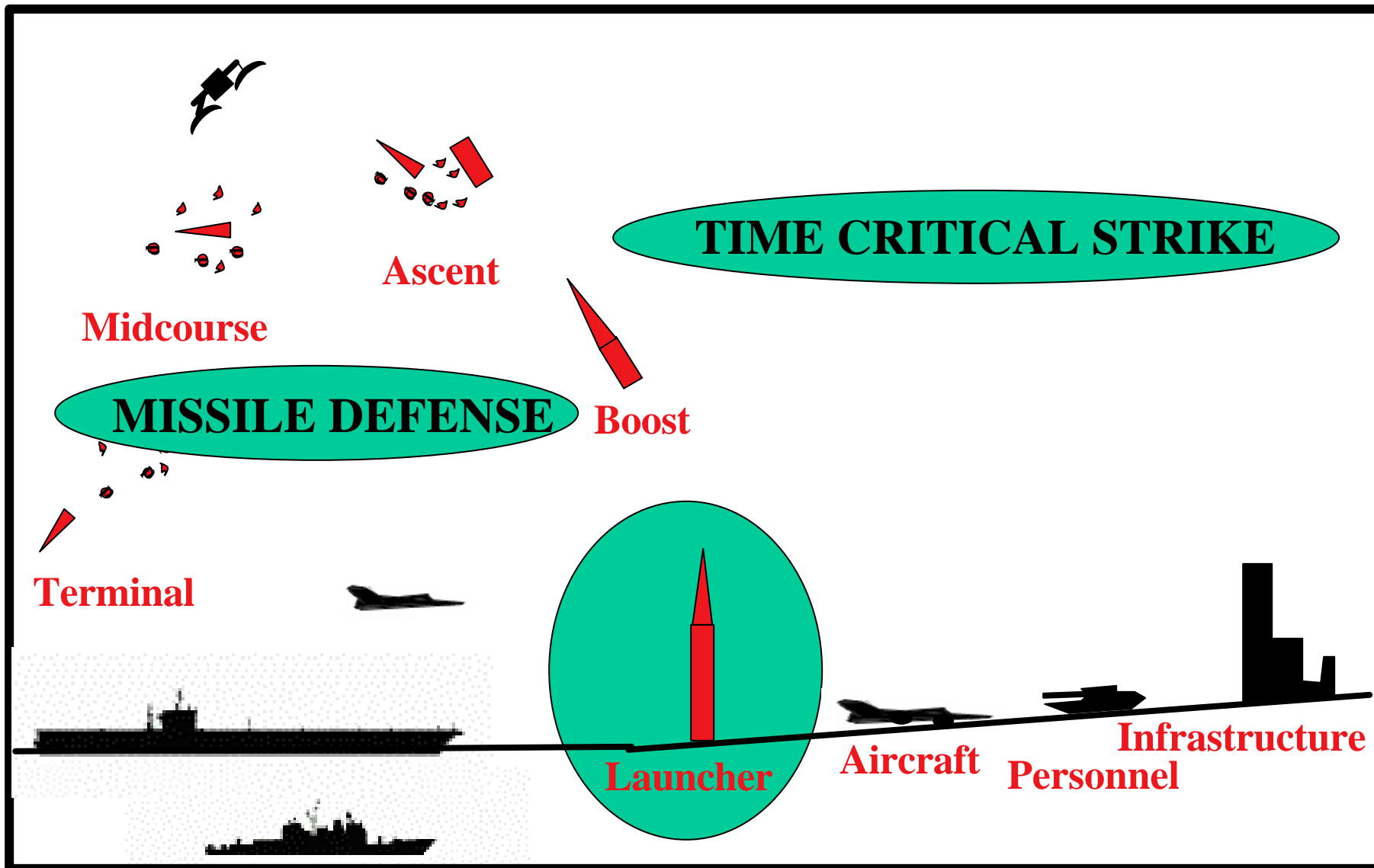


# MISSILE DEFENSE TRADITIONAL FORCES





# MISSION COORDINATION







# NDIA KEYNOTE TOPICS



**Evolutionary Fix of Legacy Systems**

**Proper Threat Physics Definition**

**Clock Speed Word Length Bandwidth**

**Defining the Readiness of Technology**

**NASA and DOD Levels of Incongruity**

**Physics Based Description of Possibilities**

**Next Hardware Emulation Architectures**

**Reimbursable Unintended Consequences**

**Joint Programs for System Science**

**People Come for Science and Money**



# INDEPENDENT OVERSIGHT MANAGEMENT

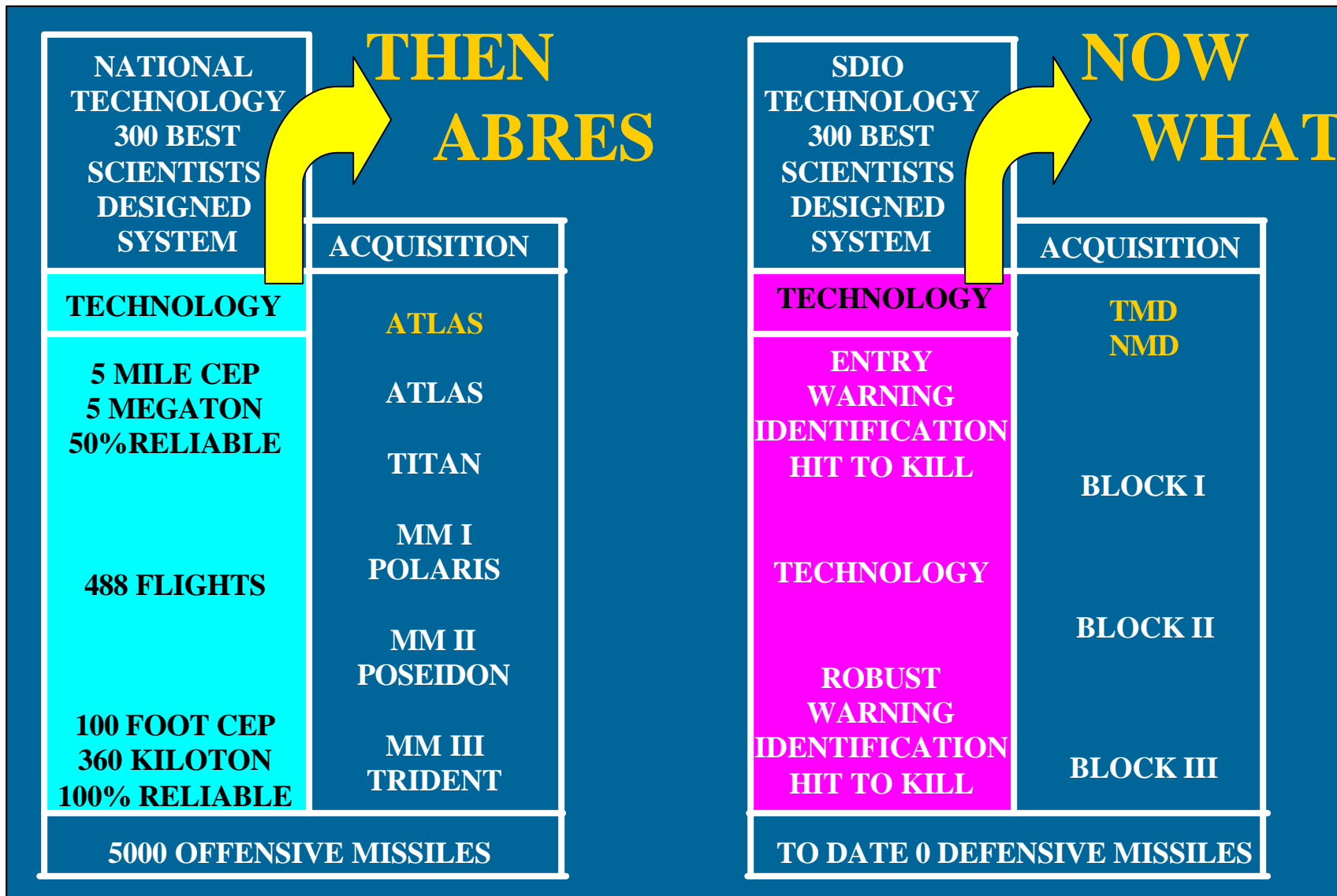


**DOD  
DIRECTIVES  
CLEARLY STATE  
INDEPENDENT  
GOVERNMENT  
ASSESSMENT  
AND DIRECTION  
OF PROGRAM  
CONTENT AND  
PROGRESS**

**ASSESSMENT MONIES AND PROGRAM MONIES  
NOT COMINGLED**

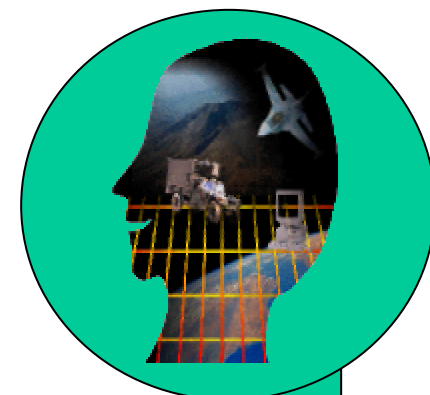
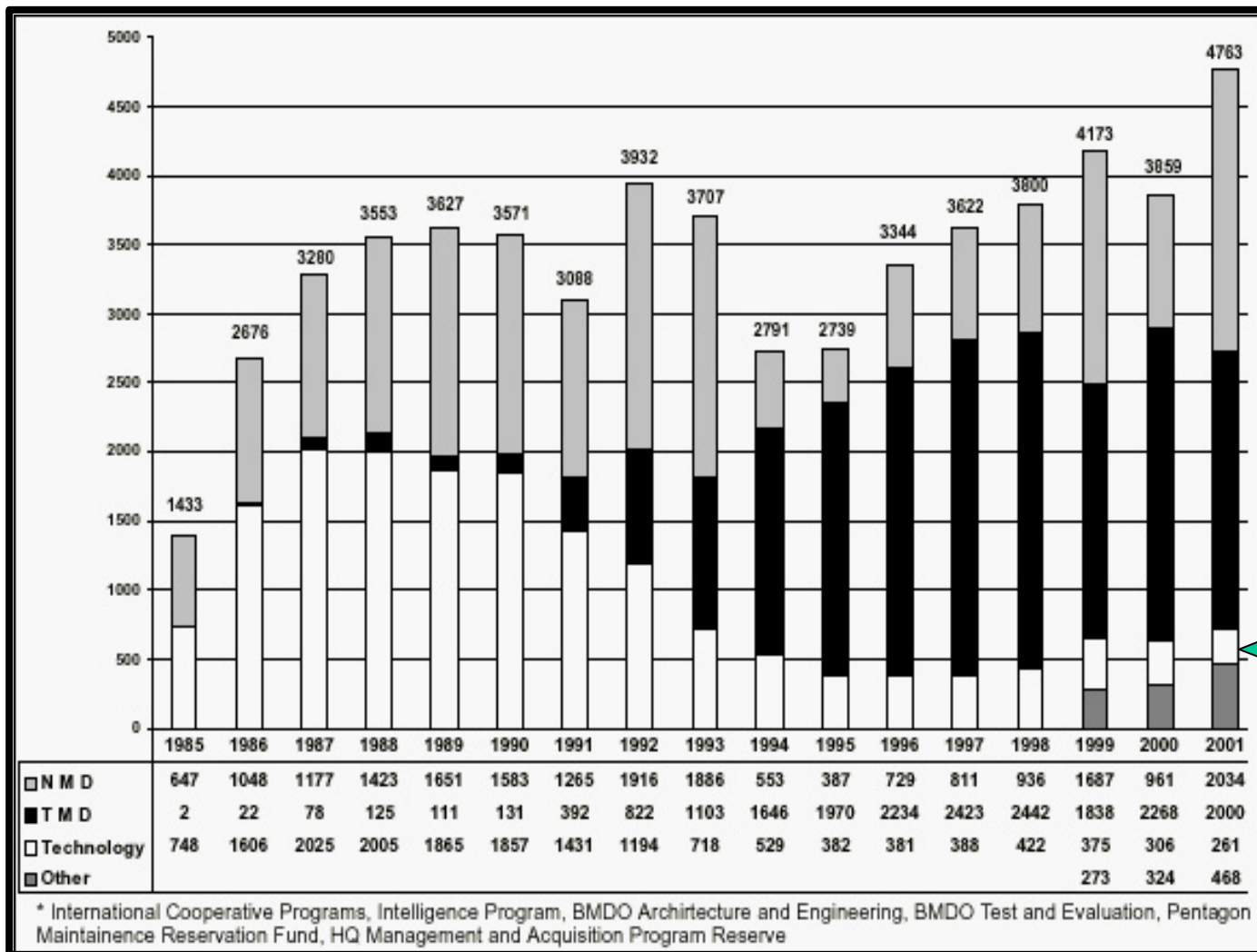


# THEN AND NOW



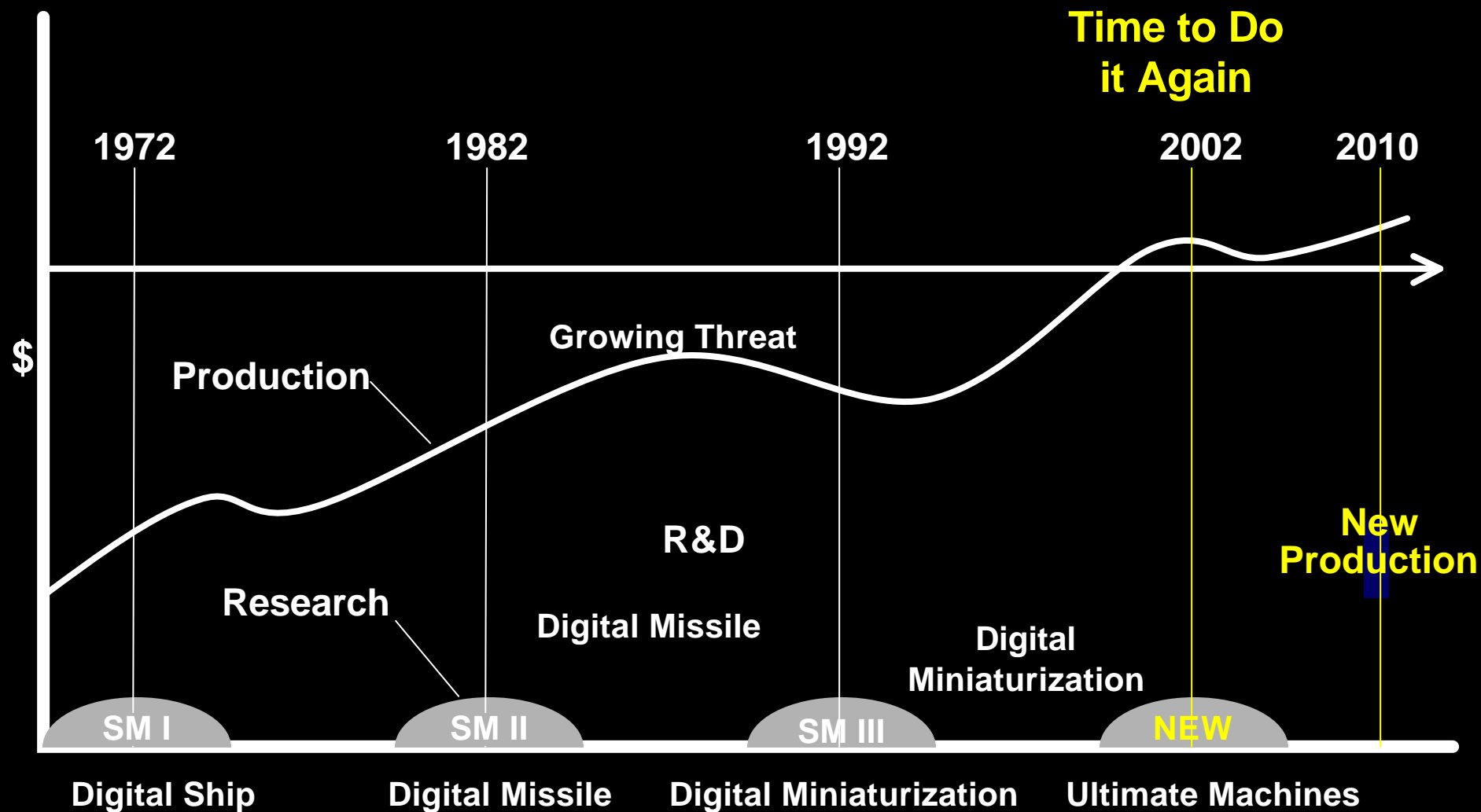


# Engineer and Scientist Program Exodus





# TECHNOLOGY BURSTS FOR NATIONAL DEFENSE







# FIX THE TALENT ATROPHY



**SYSTEM ENGINEERING**



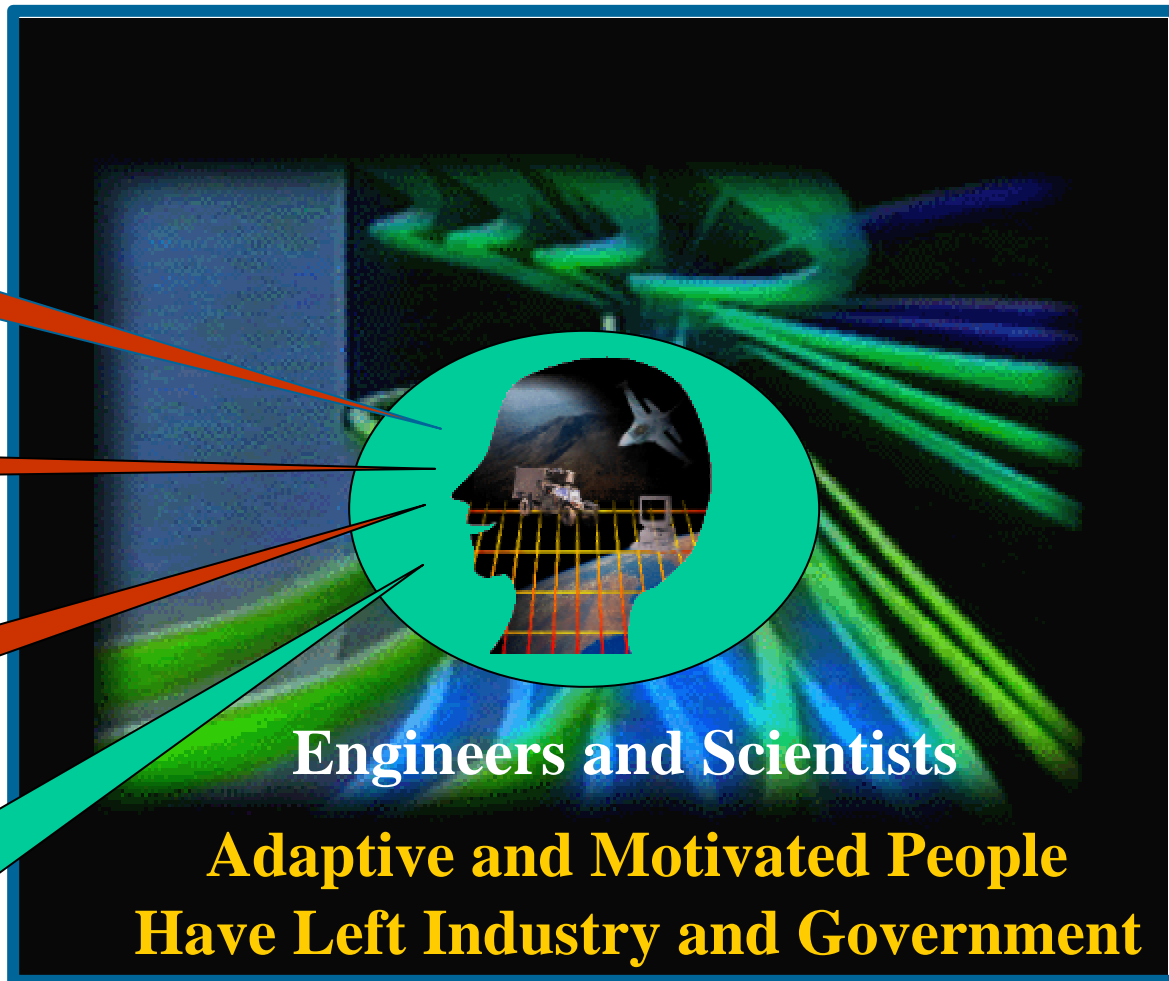
**PERSONAL ANALYSIS**



**RESEARCH PROJECTS**



**MANPOWER FOR MDAPS**





# NDIA PRESENTATION



**MICK L  
BLACKLEDGE**  
[MICK@BLACKLEDGE.NET](mailto:MICK@BLACKLEDGE.NET)

**ISSUES FOR  
SCIENCE AND  
FUTURE ACQUISITION**

